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INVESTIGATION OF MEASURING METHOD OF PCB IN GAS PHASE

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INVESTIGATION OF MEASURING METHOD OF PCB IN GAS PHASE

T. Abe and M. Sone

ABSTRACT: (Illegible)

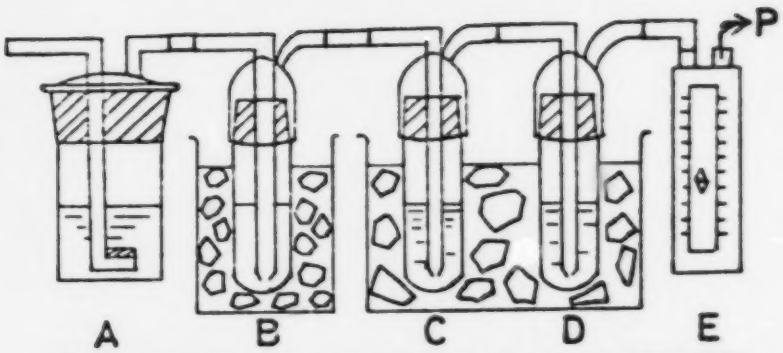
2. INVESTIGATION OF THE METHOD OF MEASUREMENT

2-1. Trapping and quantitative analysis of PCB by cool solvent.

As a method of measuring PCB in the atmosphere, we have a method which uses a special pushing pump to push and trap the components of the atmosphere in n-hexane. However, the special pump is rather expensive and also because of evaporation of n-hexane, sampling cannot be continued for a long period of time. In order to remedy these defects, we studied a method which uses n-hexane cooled to the temperature of -80° C by dry ice acetone, and usedthis n-hexane to trap and condense PCB contained in the atmosphere.

Figure 1 shows the apparatus for studying the rate of recovery. A is the PCB generator, which contains water solution of PCB. PCB vapor is generated by bubbling. B is a mist trap. This is cooled to 0° C by ice and mainly works for removing water. C is the first absorption pipe. D is the second absorption pipe. Both of them contain 50 ml of n-hexane, cooled to -80° C by dry ice acetone. F is a flow meter. This adjusts the amount of flow to 2 ℓ per minute. P is a suction pump to suck the atmosphere.

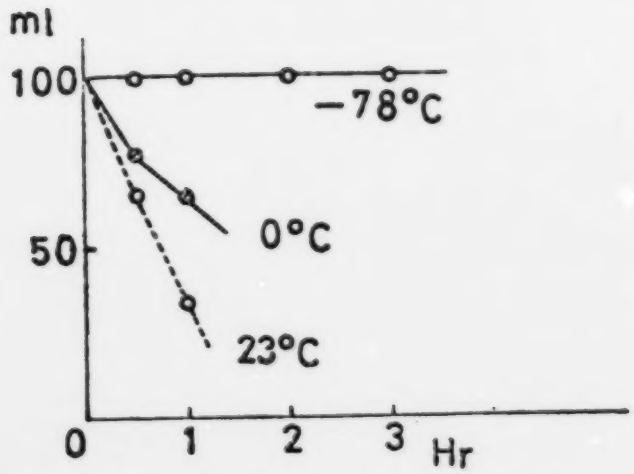
We trapped and condensed the components of the atmosphere by using n-hexane. Water was removed from it by using a liquid separation funnel. Then we condensed it using the KD condenser, refined it by a florigil column, condensed to 5 ml and sent it to gas chromatography for quantitative analysis.



PCB GENERATOR FOR EXAMINATION OF RECOVERY

(A) PCB GENERATOR
(B) MIST TRAP
(C) FIRST ABSORBENT
(D) SECOND ABSORBENT
(E) FLOW METER 2L/MIN

Figure 1



EFFECT OF BUBBLING TIME AT VARIOUS TEMPERATURES

Figure 2

2-1-1. Study of the recovery rate

Figure 2 shows the results obtained by studying the amount of evaporation when 100 ml of n-hexane cooled to -80° C by dry ice acetone was being bubbled for one minute at the rate of 2 l. Because of cooling by dry ice acetone, no significant amount of evaporation was observed even after 3 hours' bubbling.

Figure 3 shows the study in which we examined whether PCB once trapped in n-hexane would escape again due to bubbling or not. According to this experiment, PCB solution of 8 ppm did not show any change in concentration even after 3 hours' bubbling (Table 1).

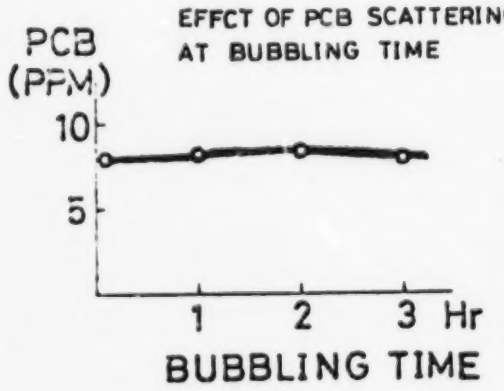


Figure 3

TABLE 1

	PCB FOUND (μg)			TOTAL RECOVERY %
	B	C	D	
KC300	20 (65)	11 (35)	00	100
KC300	45		00	100
KC500	10 (40)	15 (60)	00	100

Table 1 shows the results of the experiment testing the recovery rate. We generated PCB vapor of KC 300 and KC 500. Then we used the sampling apparatus shown in Figure 1 (B) to absorb PCB and analyzed it. Almost all PCB was absorbed before it reached the first absorption pipe. The net recovery rate was 100%.

The above-mentioned study shows that the dry ice acetone method has the advantages that n-hexane does not evaporate even after a long bubbling period, and once trapped PCB does not escape because of bubbling. Also, the recovery rate is an excellent value of 100%. Therefore, we believe that

an efficient trapping and measurement of PCB in gas phase can be done by the method.

2-2. Measurement of PCB by absorption by a filtering paper

Most of PCB in the atmosphere seems to exist in the form of mist rather than in gas phase. Therefore, we collected fine dusts floating in the atmosphere by using a high volume air sampler and studied the method which measures PCB contained in such fine dusts and which determines the concentration of PCB in the atmosphere.

2-2-1. Operation of quantitative measurement

We used a glass filter and sucked in the fine dusts in the atmosphere for 24 hours by a high volume air sampler. We placed a given amount of this filtering paper (12 x 12 cm) in the Socksley extractor, and extracted PCB by using 100 ml of n-hexane and operating for 4 - 5 hours. Then it was condensed to 5 ml by the KD condensor, and refined by a florigil column. Then, it was again condensed to 5 ml and qualitative and quantitative analysis were carried out by chromatography.

2-2-2. Study of the recovery rate

The speed of suction by a high volume air sampler is 1 m^3 per minute. We studied the rate of absorption and trapping of PCB at the speed of suction. We put a PCB standard contained in n-hexane on the glass filter, and dried it in air. Then, we sucked air at the speed of 1 m^3 per minute and studied the rate of spattering of PCB.

When we used an unused new glass filter and put the PCB standard on it and sucked air, more than 90% of PCB escaped after 32 hours. However, when we used a glass filter on which dusts were adsorbed by 24 hours' suction of air, only 20% of PCB escaped in a similar experiment. From this study, PCB adsorbed in the fine dusts floating in the atmosphere does not seem to escape

TABLE 2. THE RECOVERY RATE IN SAMPLING BY Hi-V FILTERING PAPER

Filtering paper	Amount of air flow	Time of air flow	Amt. of PCB added	Recovered amount	Recovery rate
Unused	1 m^3/min	2 Hr.	10	1.7	1.7
After 24 hours suction (covered with dusts)	1 m^3/min	24 Hr.	10	7.5	7.5

by this degree of the ventilation speed. Therefore, the PCB measurement in the atmosphere is quite possible by using a high volume air suction.

3. RESULTS OF MEASUREMENT

3-1. Measurement of PCB contained in the exhaust gas in the smoke pipe

The waste processing plant is one of the PCB sources in the state. We did trapping of PCB in the exhaust gas in the smoke pipe by using the apparatus of Figure 4. The waste processing plant contains a considerable amount of water. Therefore, if it is cooled to -80° C, ice may cause blocking. In order to avoid this, we used two mist traps and removed water. Quantitative analysis was done by the method described in 2-1.

TABLE 3. RESULTS OF MEASUREMENT OF THE EXHAUST GAS IN THE SMOKE PIPE

Place of measurement	Factory	PCB mg/m^3	Others
Sewage treatment plant of Matsumori, Sendai-City	Waste treatment plant	Less than 0.01	Electric dust collector

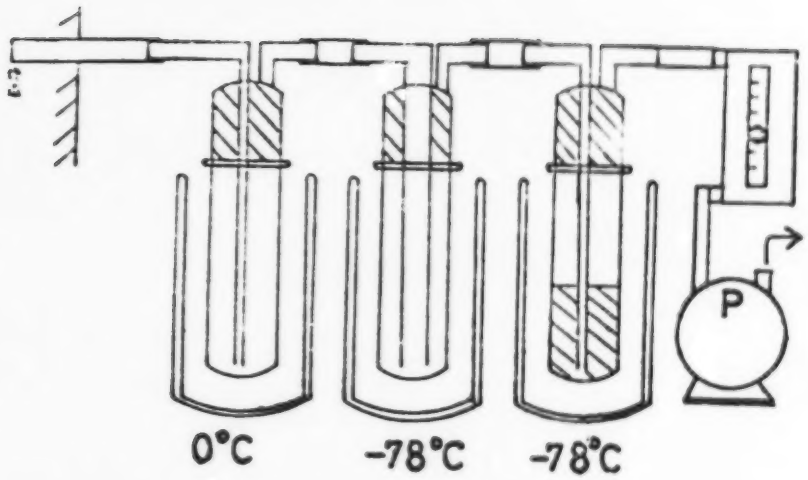


Figure 4. Apparatus for sampling PCB in the exhaust gas in the smoke pipe.

TABLE 4. ANALYTICAL RESULTS

Place of measurement	PCB ng/M^3	Date of measurement
Sendai (pollution Center)	0.0	49. 1.19
Ishimaki (Northeast of the industrial port)	0.7	48. 8.28
Furukawa (urban area)	0.0	48.11.14

3-2. Measurement of PCB in the atmosphere.

We measured PCB in the atmosphere in the state using the measuring method of 2-2. Most of the results showed only negligible amounts of PCB (see Table 4).

4. CONCLUSION

The most difficult problem in measuring PCB is the noise peak caused by the apparatus, and drugs, etc. and contamination. In the actual measurement, therefore, we must use the same apparatus and drugs to constantly carry out a blank test. We used glass filters made by Toyo Roshi and also German filters.

Both of them showed a minute PCB peak. However, this does not seem to cause any trouble in quantitative analysis.

In this state, we do not have any facilities which deal with PCB. Therefore, it seems that pollution of the atmosphere by PCB is negligible.

Abstract

Polychlorobenzene(PCB) contents in the exhausted gas from garbage combustion and in environmental air in Miyagi Prefecture were measured. For the former, the exhaust gas was sucked from the duct directly by a pump and passed through two mist traps which were maintained at 0 and -78 C and through an n-hexane trap at -78 C. It was confirmed by a preliminary experiment that a change of temperature of the n-hexane trap from room temperature to dry ice temperature prevented vaporization of n-hexane and kept the amount of n-hexane constant. The -78 C n-hexane trap could be used for a long time and PCB was trapped quantitatively. The PCB in the three traps was pooled and n-hexane was separated from water by a fractionating funnel and then concentrated by a KD concentrator, purified by fluorisil column, and finally analyzed by gas chromatography quantitatively and qualitatively. The PCB concentration in the exhaust gas from garbage combustion was below 0.01 mg/cu m. Environmental air was sucked by high volume air sampler for 24 hr and dust collected on filter paper was extracted into 100 ml of n-hexane for 4 or 5 hr. This was concentrated by KD concentrator to 5 ml and analyzed by gas chromatography after purification by fluorisil column. The PCB content in the environmental air collected at three different places in Miyagi Prefecture was below 0.7 ng/cu m.

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